

Use a #2 pencil to fill in the information on your NCS answer sheet.

- 1) Enter your **last name** and **first name** as indicated and darken the corresponding circles
  - 2) Enter your **CWID** in the spaces indicated for "Student ID" and darken the corresponding circles.
  - 3) Enter **181n** (where n = exam number = 1, 2, 3, or 4) in the spaces indicated for "**Course number**" and darken the corresponding circles.
  - 4) Enter the **form** of the exam **001 or 002** in the spaces indicated for "**SEC**" and darken the corresponding circles
  - 5) Write your **O-Key Account Username** above the words "Last Name".
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A recent article in *Scientific American* asserted that "Mitochondria generate more than 90% of a body's energy."

To test the prediction that a cell with many mitochondria would produce ATP, carbon dioxide (**CO<sub>2</sub>**) or glucose at a higher rate than within a cell with few mitochondria, a scientist grows a culture of frog muscle cells and one of frog skin cells, all taken from the same frog embryo. The scientist counts and calculates the average number of mitochondria in each cell type.

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Two dogs of the same size and weight exhibit different behaviors when the temperature drops and the ground is covered by snow. Tess is active and playful, whereas Betsy is resting on its side curled into a "fur ball".

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During cold snaps, American alligators (*A. mississippiensis*) have been observed sticking their snouts out of the water as it freezes, remaining frozen in place until the ice thaws. A scientist is conducting research on the metabolism of alligators, and wants to know how their physiology shifts while hibernating in frozen ponds.

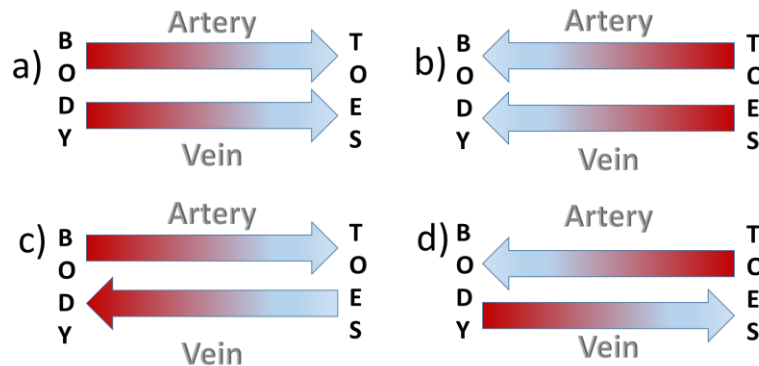
During mid-summer the alligators' mean body temperature was 38°C, and their mean **oxygen** (O<sub>2</sub>) consumption was 0.072ppm/sec/g. The scientist collects the same data on hibernating alligators.

The scientist discovered that smaller alligators reach a minimum mean body temperature sooner after the start of a cold snap than larger alligators. The scientist notes that the mean O<sub>2</sub> consumption of hibernating alligators is 0.016ppm/sec/g. When not hibernating, alligators hunt by floating near the surface of the water and ambushing animals, such as raccoons (*Procyon lotor*), which linger by the water's edge.

A biologist finds that alligators with bumpier backs, which look more like driftwood, have a greater likelihood of successfully ambushing raccoons. Conversely, raccoons with more sensitive vision are more likely to avoid these ambushes. After many generations, the scientist notes that, on average, alligators have bumpier backs and raccoons have better vision. An alligator successfully catches and eats a raccoon. A raccoon successfully avoids being caught by an alligator, and stress hormones cause the raccoon's metabolic rate to increase. A raccoon spitefully urinates into the alligator's pond. The urine reaches the alligator, which is at the other side of the pond.

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The scientist maintains both the frogs used in experiments and mice in the laboratory. To counteract heat loss, the mouse has a countercurrent exchange system in its legs. Arrows indicate flow; **darker (red) color = warmer**



Gonzo, a large macaw parrot, lives in a cage in the corner of a warm kitchen. Gonzo enjoys a diet of sunflower seeds and *Ritz* crackers as an occasional treat. The kitchen door blows open, allowing a draft of cold air onto Gonzo's cage. Gonzo's formidable beak adeptly cracks open sunflower seeds and hard-shelled nuts. Gonzo's treat of a *Ritz* cracker has lots of starch, which is made of glucose molecules.

A species of plant produces rotenone and was not affected by insects, however nowadays a species of cricket can eat leaves of this plant and the plant regrows leaves quickly.

Diuretic drugs are used to treat high blood pressure by making portions of the nephron loop **less permeable** to water. You are contracted by a hospital to test a potential diuretic drug. Twenty patients are recruited. Ten are given the drug; ten are given a placebo (solution without the drug). The only reported side-effect of the drug was a mild fever in the experimental group that raised the average **body temperature** to 38° C (control group = 37° C).

A Dr. Ann A. Robic is studying the chemistry that allows fireflies produce light. Before dissecting the insects, the scientist terminates them using cyanide, which binds to and inhibits the final electron acceptor complex in the electron transport chain (ETC), preventing the transfer of electrons to oxygen.

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To test the effect of certain inhibitors on light production, Rodionova and Petushkov (2006) added several inhibitors dissolved in methanol to a solution of luciferin and luciferase, the chemicals that produce the light, extracted from a new species of fluorescent earthworm. Below is a modified graph of their results.

